ICT PRAGUE

CHEMISTRY IS ALL AROUND NETWORK

518300-LLP-2011-IT-COMENIUS-CNW

Successful Experience in Chemistry Teaching in the Czech Republic

Lifelong Learning Programme

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Successful Experience in Chemistry Teaching in the Czech Republic

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Abstract

This work focuses the issue of successful experience in chemistry teaching. Educational system of the Czech Republic faces many problems and challenges not only in the field of natural sciences. In spite of that situation, Czech Republic has a lot of successful experience in the field of chemistry education. There are innovative teaching methods, successful projects, teachers, science experts and pedagogues, scientists, schools, students, textbooks, online portals and many activities focused on popularization of chemistry.
This report gives a brief description of the general situation in successful experience in chemistry teaching and fundamental competences that students should have in order to face the study of chemistry. The students` motivation and science teachers` lifelong learning were the main themes of the three-year activity of the Chemistry is all around us network project. The outcome of this activity is a portal with high number of teaching resources and papers focused on national and international situation in 11 European countries. During three years, a teachers` community has been created connected with associated schools and experts. This report is the outcome of the three/year process and it highlights the successful experience of each issue.
Science teachers and researchers as well as their results are very good role models for the youth. The media and society do not care about that enough and many students do not even know about that. The main idea of this report is to summarize and highlight the most successful experience and disseminate them to Czech teachers` community and society.

1. Introduction to the National Situation

Czech education system has a long tradition. First schools appeared at the beginning of the 10th century. Czech educational system used to be known for its excellent quality and competitiveness [1]. However, this reputation has been declining in the long term. The reasons for this state are: unstable political situation, changes and reforms in educational system, changes in the Czech society etc. The educational content is oriented too theoretical, based on the acquisition of facts and reproduction of definitions. Students` experiments are decreasing. Teachers and experts recognized this alarming state. Based on these facts, there are efforts to improve students` motivation and get better reputation and competitiveness for Czech education system back.
The society is changing and Czech teachers try to make the best to respond these changes. Many difficulties and problems connected with education were discussed in previous papers and national reports. This paper describes successful young chemistry contests, Chemistry Olympiad, teachers' conferences, successful portals and projects, teachers' day, new science textbooks and other popularizing activities. Each activity will be outlined below. Czech educational tradition is slowly followed by new innovative teaching methods and trends. The main teaching form is still a frontal teaching of big group of students/pupils (25 and more). Some teachers still give information and let students be passive. Reportedly, the main reasons of that are the economic situation and workload of chemistry teachers and thus low teachers` motivation. In the frontal teaching form, innovative components could be successfully incorporated (brainstorming, mind maps, students argumentation and discussion as well as ICTs). Cooperative teaching (learning) is also considered as classic teaching method. This form leads students to share, cooperate and support each other. This

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helps to understand the curriculum. It is not easy to find the most successful way. But it is important, that Czech system is changing with the changing Czech (European) society. Lifelong learning programmes, workshops, fairs and conferences inform about innovative teaching methods (each activity will be discussed below). Interesting and successful innovative methods will be discussed:

- Inquiry-based teaching in the Czech Republic
  European pedagogues are discovering inquiry-based science education (IBSE) in these days. Czech Republic also follows this trend (with a slight delay). IBSE approaches focus on student`s inquiry as the driving force for learning. Teaching is organised via questions and problems in a highly student-centred inquiry process. In IBSE, students learn through and about scientific inquiry rather than by teachers presenting scientific content knowledge. We would like to mention a successful National conference SCIENTIX which was designed primarily for teachers of elementary and secondary schools who teach maths, science and technology, and also for professionals who are involved in innovation of the areas of mathematics, science and technical subjects. (http://www.dzs.cz/cz/eun/narodni-konference-scientix/) There were practical workshops, where the participants tested a variety of innovative teaching methods in practice. The main goal of this conference was that each teacher took particular inspiration for his teaching. The conference was organized by Association of European Schoolnet (EUN) in collaboration with the Centre for International Cooperation [2].
- Project education form
  Project education form helps to motivate students to learn chemistry and to enhance competences like: cooperation, discussion, formulation of questions, problem solving, create and find information (competences necessary for laboratory work). [3]
- Open education form
  Students cooperate together (the class premises are modified to support cooperation as well as frontal or individual form of teaching chemistry). Weekly schedule informs about compulsory work and what is voluntary. It is not limited to the borderline of the school. Students choose their work activity freely but they have to carry out the schedule. [4]
- Chemistry teaching supported by ICTs.
  Information and communication technologies are becoming more and more involved as a teaching support in Czech schools (visualisation of information, communication between students, teachers, experts, support of cooperative teaching forms, support of experiments). The need of innovation and changes in chemistry teaching via new technologies is highlighted by a number of renowned authors [5]. Whiteboards are the ICT most widely used by Czech science teachers . They use it to present their powerpoint slides, or short videos of experiments, graphs, tables, virtual labs, and field trips. Information technology enables e-learning and promotes interdisciplinarity (ICTs, English). ICTs are also an integral part of the equipment for school laboratories. According to the declaration of the Czech state and the Agricultural Office, there is still not enough computers with high speed internet at Czech schools. Figure 1 shows number of computers per 100 pupils/students in 2010 [6].

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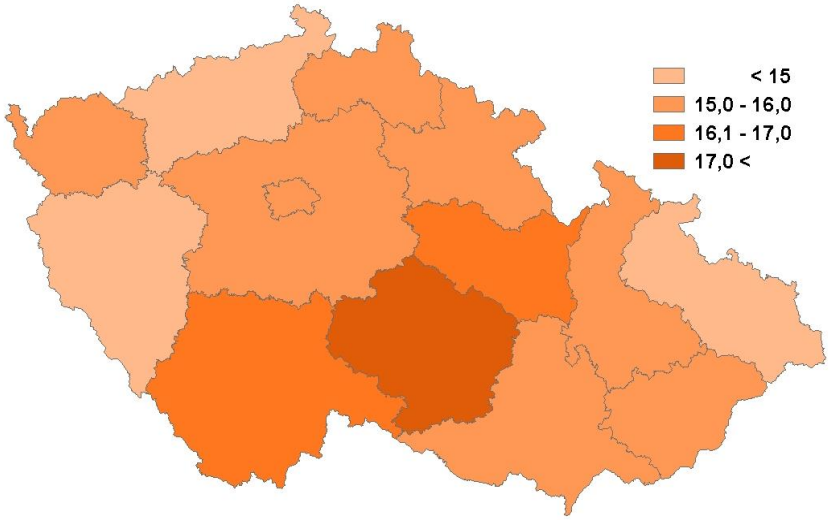

Fig. 1: Number of computers with high speed internet at schools (for 100 pupils/students), 2010. [6].

- The Institute for Support of Innovative Education
  The Institute for Support of Innovative Education is focused on supports innovative methods and trends, mediates information, initiatives for teachers, experts and schools. The institute is focused on Montessori School, Waldorf School, intercultural schools, intuitive education etc. It provides an online portal with a list of successful schools which involved innovative teaching in their daily practice [7].
- Innovative training of future teachers of chemistry
  It has been indicated that the education is going through changes and reforms. The efforts of innovative methods are visible. The Project "Innovation of professional preparation of prospective chemistry teachers" at Palacký University in Olomouc can serve as an example. This project has been co-financed by the European Social Fund and the state budget of the Czech Republic. The aim is to allow prospective chemistry teachers to be in a close contact with pupils at primary and secondary schools through management of students' projects directly in chemistry lessons, tutoring laboratory lessons, organizing Chemistry Olympiad at schools and excursions to laboratories for pupils, chemistry consultations for talented secondary school pupils, preparation of natural science competitions and popularizing events [8].
  The focus on preparation of prospective chemistry teachers has become a priority even during the International Year of Chemistry, where international student's conference *Project teaching in chemistry and related subjects* took place, organised by Faculty of Education, Charles University (Chemistry and Chemistry methodology department)..

2. Key Competences and their Development in Chemistry Education

In line with the new curricular policy principles outlined in the National Education Development Programme for the Czech Republic (the so-called "White Paper") and enshrined in the Education Act (on Pre-school, Basic, Secondary, Tertiary Professional and Other Education), a new curricular system for pupils and students from 3 to 19 years of age is being introduced into the Czech education system. Curricular documents are developed at two levels: the national level and the school level. The national level in the curricular documents system comprises the National Education Programme and Framework Educational Programmes (FEPs), see figure 2. The National Education Programme defines initial education as a whole. The Framework Educational Programmes define binding educational norms across various stages: pre-

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school education, basic education and secondary education. The school level consists of school educational programmes (SEPs), forming the basis of education at the individual schools. The framework Educational Programmes specify the level of key competencies that the pupils/students should attain when finishing their education [8].
The content of basic education within the education framework is divided into nine, roughly defined educational areas**.** Each educational area comprises one or more interlinked *educational fields*. Chemistry is included in area Humans and Nature **(**Physics, Chemistry, Natural Sciences, Geography**).**

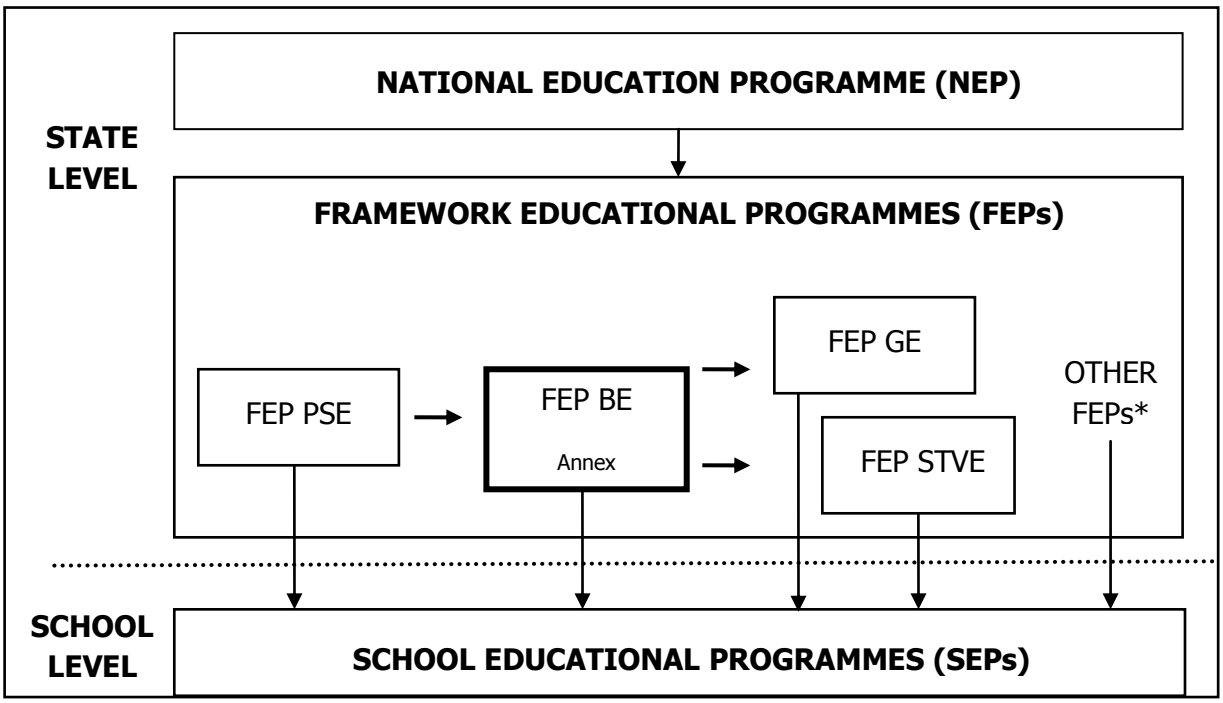

Fig.2: The system of curricular documents FEP PSE – Framework Educational Programme for Pre-School Education; FEP BE – Framework Educational Programme for Basic (i.e. primary and lower secondary) Education and Annex to the Framework Educational Programme for Basic Education Specifying the Education of Pupils with Mild Mental Disabilities (FEP BE MMD); FEP GE – Education Framework for Secondary General Education (grammar schools); FEP STVE – Framework Educational Programmes for Secondary Technical and Vocational Education. Other FEPs – additional Framework Educational Programmes defined by the Education Act - Framework Educational Programme for Basic (i.e. primary and lower secondary) Artistic Schools, Framework Educational Programme for Language Education and others. [8]*

The main competence developed on primary schools (ISCED 1 and 2) are: learning competence, competence to solve problems, competence for communication, social and personal competence, civic competence, working competence. ISCED 1 education does not include chemistry (In the *Man and his world* some workshops could be involved supporting science fields - framework educational programs support interdisciplinarity). Pupils have first chemistry education at 7th or 8th grade. The main goal of chemistry teaching at primary schools is to build complex attitude to the world of chemistry. Students get basic knowledge of major chemical industries.

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We choose a School educational program of high school in Příbram as a successful example of good practise. This school provides ISCED 2 and ISCED 3, their school educational plan demonstrate which competences should be developed during the school attendance [9]:

1) Learning competencies:
   - the teacher motivates pupils via experiments and teaching aids,
   - the teacher leads pupils to discuss, prepare papers
   - the teacher helps students to choose quality information, textbooks, resources (for example CIAAN portal) and other literature.
   - the teacher summarizes the curriculum, (positively) evaluates the activity and performance of students
2) Competence to solve problems:
   - the teacher leads pupils to individual work in the laboratories, (s)he leads students to search for best practices, goals and conclusions.
3) Communicative competence
   - the teacher requires the correct use of terminology when answering a presentation of the tasks
   - the teacher supports informative communication between pupils and between pupils and teachers.
4) Social and personal competence:
   - the teacher ensures the responsible compliance with operating rules of chemical laboratory, safety rules and first aid
   - the teacher promotes mutual assistance in laboratory exercises and helps weaker students.
5) Civic competence
   - the teacher ensures the investigation equipment of the school
   - the teacher leads students to require mutual cooperation and also supports individual students` skills and abilities.
6) Working competence
   -teacher leads students to handle properly the laboratory equipment and tools as well as to find the most effective solutions of the problem.

School educational program (chemistry) ISCED 3 builds on the skills acquired in ISCED 2. Students are supported to take part in national and international contests, extending the particular issues and broadening the knowledge and competence[9].

3. Examples of Successful Experience

There are many nice examples of successful practice in the Czech Republic. For better clarity, we have tried to give examples from all over the range of chemistry teaching. We are fully aware of some topics that could be placed into more chapters. All chapters are very closely related to each other and one would not exist without the other.

3.1 Experience description

3.1.1 Successful chemistry contests designed for increase of pupils'/students' motivation

There are many contests and projects seeking gifted and talented pupils and students. And there are many pupils and students who achieved great results in these competitions and projects. One of these contests is described in an article named "The High School Science Talents". It deals with excellent results of four high school students who succeeded in national and international scientific competitions (Expo Science 2012 AMAVET, Professional activity of students etc.) After that some of them participated in students' activities in the USA and Russia. The winners of the competitions currently study chemistry at universities and further develop their interests and talent. [10] A review of this article was uploaded on the CIAAN project portal.
Many more science contests are organized in the Czech Republic. Some of them will be described:

- The Young Chemist contest
  Nice example of a national contest could be a national chemical competition named Young Chemist, organized by University Pardubice. The contest is designed for elementary school pupils

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interested in chemistry. The competition was attended by 5,000 pupils in 2013. The first part of the contest is a test and written assignment. Successful solvers continue in the second part of the contest in labs and only the best of them continue in the national part. The best solvers of the third part were rewarded (a certificate of merit and material rewards) and national title of champion. [11]

- The Chemistry Olympics
  Primary and secondary school pupils/students can participate in international Chemistry Olympics. The idea of the International Chemistry Olympiad was developed in the former Czechoslovakia in 1968. It was designed with the aim to increase the number of international contacts and the exchange of information between nations. The 45th International Chemistry Olympiad was held at Moscow State University on 15 - 24th July 2013. The Czech team won four medals there - three silver and one bronze. [12]
- ICT Prague organizes a photographic competition named “Chemistry Is Cool”. The aim of the contest is to find the best photo with chemical topic as well as to find the interest in chemistry.
- Widely known is also a contest called “High school science activity” aimed at secondary school students who prepare scientific projects, individual or collective, in any of 18 fields including chemistry. They have to defence their project before the committee. Successful students can continue in international competitions. [13]

3.1.2 Successful teachers

Number of young science teachers is lowering and the teaching staff is getting older (it is the fourth oldest of the twenty-seven European Union countries). Offices and schools are trying to break this trend. In this report, we have chosen one of many successful teachers and one of many successful projects designed for teachers.

- Chemistry Teachers Inventions Fair
  The fair is organized annually at high school in Tábor. Teachers themselves take part demonstrating their experiments they use when teaching. That ways they inspire each other. We consider all the participating teachers as an example of successful experience because they are motivated for lifelong chemistry activities to extend their skills and to improve their teaching of chemistry. The fair has been described in article named “Chemistry Teachers Inventions Fair” published in the Comenius Journal [14] (see also 2.4); the review is available on the CIAAN project portal.
- EDUin project
  Teachers` profession is perceived as unpopular and uninteresting by Czech society. New EDUin portal designed for teachers, students and general public tries to change this state. The portal shows education and teaching as a societal issue, informs about new interesting events, successful schools, teachers and students. It helps to improve communication between the media and the professional community. EDUin portal also describes successful project „Chci učit“ (I want to teach) which aims to show teachers as successful experts, as a crucial factor to offer a quality education for children and students. EDUin project aims to support teachers` profession.
  This project tries to find interesting teachers who will inspire young people (maybe also potential new teachers) and emphasize teaching profession [15].
- International Teachers' Day
  The worldwide celebrated Teachers' Day belongs to October 5. The Czech Republic celebrates this event on March 28 - it is the anniversary of the birth of John Amos Comenius (28 March 1592). A part of the celebration is the annual awards ceremony and announcement of results of the contest Golden Amos for best Czech teachers.
- The Golden Amos (Comenius)
  The Golden Amos is a contest designed for teachers and their pupils or students. Children vote for the best teacher. The mission is to popularize especially teachers, who, according to the assessment of children, contribute significantly to shaping the quality of relationships between educators and children. As the best teacher of the Czech Republic in 2012/2013 was elected Ms.

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Růžena Hlůšková from the elementary school in Kunovice who is a chemistry teacher. Also in 2013/2014, the best teacher elected was a chemistry teacher, Ivana Hájková from the high school of Jiří Wolker, Prostějov.[16]

3.1.3 Successful projects and portals

There are many projects focused on popularization of chemistry between students and the general public. Some of the projects are supported by Ministry of Education, Youth and Sports or by universities and colleges. Others are funded by chemical companies and private bodies.

- The Talnet project
  This successful project is described in an article named “Talnet - A Project for Curious Youth” by Lucie Kettnerová, published on the iForum portal of the Charles University in Prague. [17] The author describes the project designed for talented pupils, offering various activities, e.g. lectures, summer camps, international meetings, connection with experts. The main activity of the project is to search young people interested in natural sciences and engineering and to increase their interest. Talnet offers activities for those interested in science, technology and mathematics. This program is opened to every pupil, there is no pre-selection, nor are there any age restrictions. Activities’ difficulty level corresponds to high school students with above average interest in the field. The review of the article has been uploaded on the project portal.
- iForum – a portal of the Charles University.
  The portal informs about current events at the university. It is focused on students but there is a lot of information for general public too. Its aim is to attract young people to science. For example, section named “Science at the Charles University” shows science topics in an attractive way. [18]
- Débrouillards club
  A nice example of good practice is the Débrouillards club. It is a movement that came to us from Canada and it is focused on after-school science activities. There are many Débrouillards clubs in the Czech Republic. One small special school joined the Débrouillards as a first special school. Children with study disabilities are inquisitive and interested in the experiments too. They focus on the activity itself, they do not seek answers on scientific questions, they do not solve the chemical formulas. This school overcame the barriers and chemistry is taught there as well. The activity is described in article named “Experiments as Elsewhere, Just a Little Easier (by Dr. Radmil Švancar). [19] This article was published in The Teachers’ journal and the review of it has been uploaded on the CIAAN project portal.
- The Czech Chemistry portal
  The Czech Chemistry portal is striving to increase students’ motivation. The main aim of this portal is to inform students about new developments in chemistry. It is designed for primary school pupils as well as for secondary school and university students and graduates. The portal also provides online counselling, which eases establishing new contacts between students and professionals. [20]
- The STEP project
  Institute of Chemical Technology Prague organizes a project called “STEP” to popularize science, research and development and their results. It attempts to increase primary and secondary school students' motivation to study technical and natural sciences, and subsequently to be interested in work in the field of R&D. The project STEP wants to communicate science and technology to the target groups in understandable way and to develop cooperation among elementary and secondary schools across the Czech Republic. This project is described in an article named “STEP – Step towards the Popularization of Research and Technology” (by Dr. Hana Bartková and Jitka Svatošová) which is uploaded on the CIAAN project portal. [21]

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Fig. 3: Photo was taken during STEP aktivity named Science fair, which was attended by more than 2000 participants.

- Science for you project
  The Academy of Sciences of the Czech Republic offers a project named *Science for you*. The project popularizes researches in a comprehensible form, organizes excursions and science festivals for students and the general public.

3.1.4 Successful journals and books

- The Comenius Journal (Komenský)
  The journal was founded in 1873, now it has been the oldest pedagogical journal. It presents papers, experiences and ideas, reports, reviews of books and a number of other insights focused on education from the Czech Republic and from abroad. [14]
- Teachers' journal
  The Teachers' journal is the most widely used weekly magazine for teachers. It informs about current events in education. The magazine has 32 coloured pages full of interviews, analyses, reports, commentaries, expert advice, counselling and information from the Czech Republic and from abroad. It is based on 130 years of tradition. [22]
- Chemistry textbooks
  There is no ample choice of quality and modern chemistry textbooks in the Czech Republic. Pupils and students often learn from outdated textbooks that do not correspond with current knowledge. We would like to mention two successful textbooks: Chemistry for 8th grade of primary school by Škoda and Doulík. [23] It is a modern textbook that works with whiteboards and other ICT technologies. It was published in 2006 and nowadays it belongs to the latest chemistry textbooks in the Czech Republic. The textbook was awarded a gold medal as the best textbook for elementary schools in Europe at the Book Fair in Frankfurt, 2008. The second example of a successful textbook is Chemistry for high schools by Honza and Mareček [24]. These are probably the most used chemistry textbooks.

3.1.5 Successful conferences and programmes of lifelong learning

There are organized many conferences focused on science teaching and popularization in the Czech Republic. For example successful international conference organized by *Open Science* - Project of Academy of science. It was held on February 2014 in the National technical library in Prague.
Some programmes are successfully repeated every year. For example *Science* fair will be held in Brno in summer 2014. Nice example of an annual activity is also *Summer school* designed for chemistry teachers and their students, organized by ICT Prague.

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3.1.6 Media and science teaching

There are some interesting TV programmes for kids and students focused on science teaching in the Czech television. The Czech television has a long tradition of creating national educational programmes for children and youth. These programmes are created by team of experts, teachers, scientists and have very good quality. Every science teacher knows the educational programme named Magion, which was focused on science and mysteries of nature. This tradition has been followed with programs of various quality. Every young man knows the programme named Port, a very successful and popular educational program for youth which, unfortunately, was finished last year. .

Now, Czech TV is searching a new way to popularization of science. There are some new programmes designed for pre-school children named TVminiUNI (Television Mini University) which is very successful. It explains various mysteries of nature in a simply way. It teaches children to ask and observe the world around us (chemistry included). There are some fairy tale characters as well as experts and scientists from different universities and scientific centres in this programme.

Fig. 4: Dr. Michael Londesborough, one of the most popular science teachers and scientists, the moderator of the PORT programme. Photo by nationalgeografic.cz

3.2 Experience assessment

There is a lot of successful experience in the Czech chemistry teaching. During the tree-year programme of the Chemistry is all around us network we have recognized a large number of activities designed for pupils and students, associations, experts, teachers, schools, institutions, textbooks, websites, portals, etc.. We created simply criteria to choose the most important and successful activities:

- number of involved pupils/students: We searched for big projects (like Chemistry Olympiad, STEP) which involved a lot of students, teachers, experts. We focused also on smaller projects designed for pupils/students with some disadvantages (Leisure activity Debrouijards) or talented students (TALNET).
- activities carried out (workshops for students, students` national and international contests, etc.)
- key competences and their development in chemistry education,
- reach and impact of the activity, quality and content of the activity (The Comenius journal),
- experience of the activity organizers etc.
- We focused also on successful innovative teaching methods, which increase students` motivation (inquiry based teaching- National conference SCIENTIX)
- We looked for successful experts who popularizing chemistry, interesting websites and portals attractive for pupils/students (websites iForum.cz)
- activities supporting lifelong learning (Teachers` invention fair).

The *Chemistry is all around us network* shows interesting resources and papers describing these activities, supporting teachers and experts to be active and to cooperate with each other.

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Each outcome will be discussed further.

4. The Impact of the Project on Successful Experience

4.1 Workshop for science teachers organized by ICT Prague (within CIAAN)

Collaboration between teachers and experts in the field of chemistry proceeded also at the workshop of this project where the teachers could get to know new results of some actual scientific research carried out at ICT Prague. There took place communication not only between the project members and the teachers but also between the teachers and the scientists.

The first part of the workshop was focused on different views of chemistry teaching. There were presented two lectures on successful experience in chemistry education.

- First lecture was organized by Dr. Stejskalová, who presented projects organized by Academy of Sciences designed to support popularization of science. The teachers discussed their opinion on this topic after the lecture. They focused on role of school science experiments and barriers for their implementation.
- The second lecture was organized by Mrs. Lada Macháčová who is a teacher at a high school in Přerov. We can highlight that the school organizes meetings for their colleagues from other schools periodically and many other activities for students.
- Zdeněk Hrdlička presented the CIAAN project. Information about need of the comments was included.

Fig. 5: Workshop for science teachers organized by ICT Prague

Teachers were informed about new materials available on the project portal (Database of publications in the section Successful experience).

1) Chemistry teacher's invention fair
2) STEP - Step toward the Popularization of Research and Technology
3) Experiments as elsewhere, just a little easier
4) Talnet - a project for curious youth
5) High School Science Talents

To get more information about teachers` opinion on actual situation in successful experience in Czech republic, a short questionnaire was developed. There were quesions on four main topics:

1. What made you most pleased during your teaching practise?

   '*Students, who have succeeded in science competitions, Chemistry Olympiad and who study chemistry at universities. Students still like science and some of them are still motivated to study and do experiments. Good relationships with pupils/students, appreciation.*'

   '*Successful projects for students.*'

   One successful experience is really remarkable - students composed a song for their chemistry teacher. You can find it here: http://www.youtube.com/watch?v=XLJKJEmJ6qM. It is about the periodic table of the elements.

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2. Interesting experience from practice

‘*Cooperation with science centres like the Academy of Sciences, the Charles University, ICT Prague.* ’ *‘Students can take an excursion there, or take part in some projects (for example students` internships).* ’

‘They can see what the real science is and get contacts with experts. The students can try to take a part in some science competitions.’

3. Barriers to get new successful experiences

‘Lack of interest and poor relationships with parents.’

‘Students are afraid from failure.’

‘Too much ICT (for example smart phones, MP3…)’

‘Legislation and lack of funds for laboratory equipment.’

4. What could help them to overcome the barriers?

‘Greater support from the state and better communication with parents (more understanding).’

‘More science experiments, less ICT presentations.’

‘Text book for beginning chemistry teachers.’

‘CIAAN project as a useful source of inspiration. ’

The end of the workshop was saved for discussion of participants, questions and answers. Teachers discussed their problems very actively. Especially the topic of decreasing science experiments at schools. They also discussed successful experience a lot. They praised successful projects focused on science popularization like CIAAN. These projects help them to motivate students in their classes. Projects help them to find good resources for teaching and many more.

4.2 Testing of ICTs

- Results of Teaching Resources Testing

Mrs. Pavlína Jiroušková, who is a science teacher at Lauder school of Prague tested resource named The Water Filtration ((http://chemistrynetwork.pixel-online.org/TRS_scheda.php?art_id=36&lck=&top=&pep=&sua=&tgl=&ltr=3&q=water)). Lauder school is an associated school of CIAAN project. The school offers children leisure activities focused on chemistry education.

The resource was used to obtain ideas and information for small group of students. Outcomes of using the resource were interactive models, papers, posters and many more. The group of students presented the outcomes to their schoolmates of Lauder schools. The presentation was focused on water characteristics and water recycling in the past, today and in the future.

- Information about the class

  Mixed age group of eight students (lower high school) worked together as an educational group. Older students cooperated with younger ones. They worked as a real team for four days. After that they prepared a presentation. The presentation was involved in the whole-school project named “So that there is no deluge after us”. The school project was presented in Korunní Theatre at Prague (http://www.divadlokorunni.cz/). Approximately 12 groups of students presented their outcomes there (not just the chemistry leisure club). The main topics of all the students groups were recycling, ecology, green architecture and so on. About 150 children were present in the auditorium of the theatre; there were students, their teachers and parents.

- Suggestion for use

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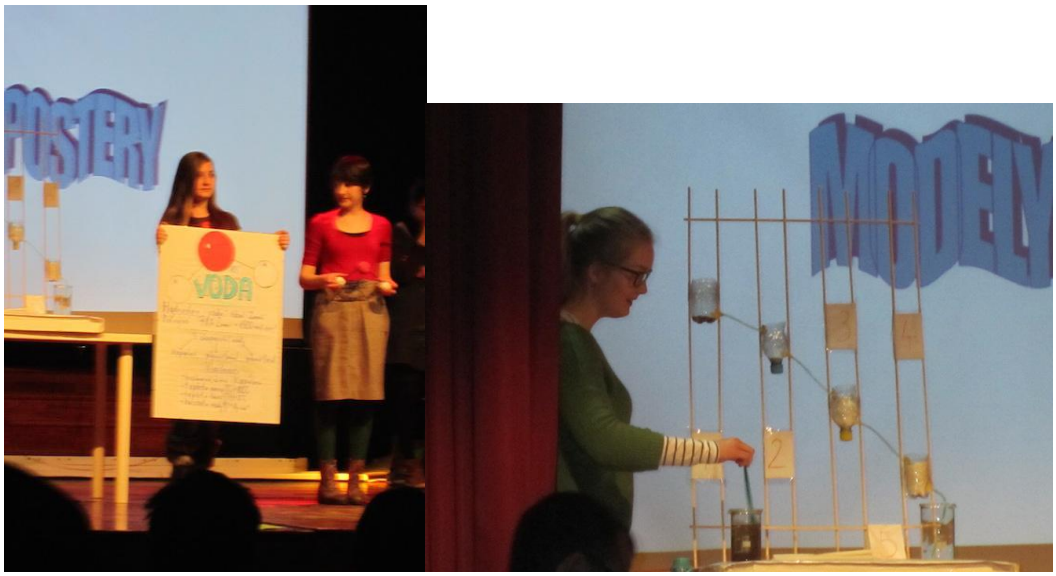

Fig. 6: Students of Lauder Schools of Prague presenting the project results.

1. Students learned about water and environment.
They used some textbooks and ICT and they learned together in an educational group with their chemistry teacher.
2. Students used resources on CIAAN portal and chose the most related resources to their topic.
3. Together with their teacher, they learned characteristics of the water, structures, reactions and water treatment and used the resource named Chemistry and Water Treatment. They discussed animation demonstrating water filtration.
4. They created a real model that can filter coloured water to clear water. They used PET bottles, sand and other needs for that.
5. Students prepared a show for their schoolmates. During the show they explained principles of water filtration and added some posters and banners. They also explained structure and some chemical properties of water, and showed how water purifier works. The show was presented to approximately 150 people.
6. Students will exhibit the models and posters at the Lauder schools premises. Other students will use the models in the future.

- Considerations about the resource: Students prepared presentation for 150 people and after that they received great applause from other students, teachers and parents who attended the theatre. Students had the joy of success, it was certainly encouraging them for the further study of chemistry
- Teacher's conclusions:
  - Students were very active and inquisitive. They cooperated together very well and prepared useful models of water filtration. The teacher evaluated the CIAAN portal and resources very positively. She will use its resources further.
  - It was motivating that resources were in English but it was problematic too. The teacher did not speak English but students and other teachers helped her with translation.

5. Conclusion

We have described the general situation in the Czech educational system, focusing its problems and challenges. Nevertheless, we have reported many examples of successful experience in the field of

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chemistry education, e.g. innovative teaching methods, successful teachers and scientists, schools, students, textbooks, online portals and many activities focused on popularization of chemistry. These activities should be further developed and supported by school headmasters, parents, local and national authorities. The key factor necessary for such successful experiences seems to be motivation, i.e. (i) motivation of students to learn chemistry (or science in general) and (ii) motivation of teachers to undergo in-service training, to self-educate themselves during their whole professional life.

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